DISCIPLINE SPECIFIC ELECTIVES (DSE) COURSES OFFERED BY THE DEPARTMENT

DISCIPLINE SPECIFIC ELECTIVES (DSE-1)

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Internet of Things	4	3	-	1	Class XII passed with Physics + Mathematics/Applied Mathematics + Chemistry OR Physics + Mathematics/Applied Mathematics + Computer Science/Informatics Practices	Digital Electronics (DSC-5 , Sem II) , Basic Instrumentation & Measurement Techniques (DSC-4, Sem 2)

Learning Objectives

This course describes the Internet of Things (IoT), the technology used to build these kinds of devices, how they communicate, how they store data, and the kinds of distributed systems needed to support them. Broad objectives are:

- To introduce the terminology, technology and its applications
- To introduce the concept of M2M (machine to machine) with necessary protocols
- To introduce the Python Scripting Language commonly used in IoT devices/systems
- To introduce the Arduino / Raspberry Pi platform, widely used in IoT applications
- To introduce the implementation of web-based services on IoT devices

Learning outcomes

The Learning Outcomes of this course are as follows:

- Understand internet of Things, its hardware and software components and the IoT value chain structure (device, data cloud).
- Interface I/O devices, sensors & communication modules.

- Understand IoT sensors and technological challenges faced by IoT devices, with a focus on wireless, energy, power, and sensing modules
- Remotely monitor data and control devices and develop real life IoT based projects.

SYLLABUS OF ELDSE-2A **Total Hours- Theory: 45 Hours, Practicals: 30 Hours**

UNIT – I (11 Hours)

Introduction to Internet of Things - Definition and Characteristics of IoT, Architectural overview (cellular, star, mesh, ring)

Physical design of IoT: Things in IoT, IoT protocols in Link Layer, Network/Internet Layer, Transport Layer, Application Layer (with specific reference to Communication protocols as MQTT, ZigBee, Bluetooth, CoAP, UDP, TCP, WebSocket etc.,), Basics of Networking, Security aspects in IoT.

Logical design of IoT: Functional blocks, Communication Models, Communication APIs, Enabling Technologies, IoT levels and deployment templates, Design principles IoT and M2M- Definitions, differences between M2M & IoT systems, Software defined networks (SDN), network function virtualization (NFV), difference between SDN and NFV for IoT, Basics of IoT System Management with SNMP, NETCONF -YANG

UNIT – II (11 Hours)

Transducers, Sensors and Actuators: Review of Transducers, Concept of Sensing and Actuation, Sensor characteristics (static/dynamic), Sensor classification (passive/active, analog/digital, scalar/vector), Actuator classification (Electric/Fluid Power/ Linear Chain /Manual / Linear vs Rotary)

Types of Sensors: Contact and Proximity, Position, Velocity, Force, Humidity, Tactile unipolar and bipolar Stepper motors Sensors- Light sensor, temperature sensor, voltage sensor, ADC and DAC, Temperature and Humidity Sensor DHT11, Motion Detection Sensors, Wireless Bluetooth Sensors, Level Sensors, USB Sensors, Embedded Sensors, Distance Measurement with ultrasound sensor etc.

Selection of Transducers for various IoT applications, Wireless Sensor Networks

UNIT – III (12Hours)

Computing (using Arduino, Raspberry Pi), I/O interfaces.

Software components- Programming API's (using Python/Node.js/Arduino). Introduction to Arduino/Raspberry Pi- Installation, Interfaces (serial, SPI, I2C)

Raspberry Pi: Communication with devices through the pins of the Raspberry Pi, RPi. GPIO library, Python Functions, setting up the pins, General purpose IO Pins, Protocol Pins, GPIO Access, applying digital voltages, and generating Pulse Width Modulated signals, Tkinter Python library, accessing pins through a graphic user interface

OR

Arduino: Introduction to the Arduino environment, the Arduino board, the Arduino IDE, and the Arduino compatible shields together with their libraries. Arduino board main components, inputs, and outputs. Arduino Integrated Development Environment (IDE), Compiling Code, Arduino Shields and Libraries.

Basics of C programming, composition of an Arduino programs, Arduino tool chain, Arduino IDE, basic structure of a sketch, including the use of the setup() and loop() functions. Accessing the pins from a sketch for input and output, introduction on debugging embedded software on an Arduino, UART communication protocol, Synchronization, parity and stop, the use of the Serial library to communicate with the Arduino through the serial monitor.

Programming – Python programs with Arduino/Raspberry Pi with focus on interfacing external gadgets, controlling output, reading input from pins

Note: It is optional to choose either Arduino or Raspberry Pi environment

UNIT – IV (11 Hours)

IoT Physical Devices and Endpoints, Domain specific IoTs, IoT Physical Servers and Cloud Offerings

Cloud Computing: Characteristics, Introduction to Cloud Service models (SaaS, PaaS, IaaS, XaaS etc.,) Deployment models, Cloud storage APIs, IoT-Cloud convergence, Communication Enablers

Webservices – Web server for IoT, Python-Web frameworks, RESTful Web API, ThingSpeak API, MQTT, IoT security, Basics of symmetric and non-symmetric encryption standards

IoT Application Development - Solution framework for IoT applications-Implementation of Device integration, Data acquisition and integration

Device data storage- Unstructured data storage on cloud/local server, Authentication, authorization of devices.

IoT Case Studies based on Smart Environment, Industrial automation, Transportation, Agriculture, Healthcare, Home Automation

Practical component (if any) – Internet of Things

Learning outcomes

The Learning Outcomes of this course are as follows:

- Interfacing of various sensors using Arduino/Raspberry Pi
- Interfacing using Bluetooth, Web server, TCP, ThinkSpeak Cloud, MQTT broker

LIST OF PRACTICALS (Total Practical Hours- 30 Hours)

1. Connect an LED to GPIO pin 24 and a Switch to GPIO 25 and control the LED with the switch. The state of LED should toggle with every press of the switch.
2. To interface DHT11 sensor with Arduino/Raspberry Pi and write a program to print temperature and humidity readings.
3. To interface motor using relay with Arduino/Raspberry Pi and write a program to turn ON motor when push button is pressed.

4. To interface Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data to smartphone using Bluetooth.
5. To interface Bluetooth with Arduino/Raspberry Pi and write a program to turn LED ON/OFF when '1'/'0' is received from smartphone using Bluetooth.
6. Create a traffic light signal with three colored lights (Red, Orange and Green) with a duty cycle of 5-2-10 seconds.
7. Create an application that has three LEDs (Red, Green and white). The LEDs should follow the cycle (All Off, Red On, Green On, White On) for each clap (use sound sensor).
8. Write a program on Arduino/Raspberry Pi to upload/retrieve temperature and humidity data using ThingSpeak cloud.
9. Write a program on Arduino/Raspberry Pi to publish/subscribe temperature data using MQTT broker.
10. To install MySQL database on Raspberry Pi and perform basic SQL queries.
11. Write a program to create TCP server on Arduino/Raspberry Pi and respond with humidity data to TCP client when requested.
12. Create a web application for the above applications wherever possible with functionalities to get input and send output.

Note: Students shall sincerely work towards completing all the above listed practicals for this course. In any circumstance, the completed number of practicals shall not be less than eleven.

Essential/recommended readings

1. Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547
2. Dr. SRN Reddy, Rachit Thukral and Manasi Mishra, "Introduction to Internet of Things: A practical Approach", ETI Labs
3. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759
4. Raspberry Pi Cookbook, Software and Hardware Problems and solutions, Simon Monk, O'Reilly (SPD), 2016, ISBN 7989352133895
5. Adrian McEwen, "Designing the Internet of Things", Wiley

Suggestive readings

1. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015 Editors Ovidiu Vermesan
2. Peter Friess,'Internet of Things – From Research and Innovation to Market Deployment', River Publishers, 2014
3. N. Ida, Sensors, Actuators and Their Interfaces, SciTech Publishers, 2014.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC ELECTIVES (DSE-2)

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Operating Systems	4	3	-	1	Class XII passed with Physics + Mathematics/Applied Mathematics + Chemistry OR Physics + Mathematics/Applied Mathematics + Computer Science/Informatics Practices	Programming Fundamentals using Python (DSC-1, Sem I)/ Algorithm Design and Analysis(DSE-1B, Sem III)

Learning Objectives

COURSE OVERVIEW: Operating systems course is intended as a general introduction to the techniques used to implement operating systems and related kinds of systems software. The topics covered will be functions and structure of operating systems, process management (creation, synchronization, and communication); processor scheduling; deadlock prevention, avoidance, and recovery; main-memory management; virtual memory management (swapping, paging, segmentation and page-replacement algorithms); control of disks and file-system structure and implementation.

The Learning Objectives of this course are as follows:

- To explain main components of OS and their working
- To familiarize the operations performed by OS as a resource Manager
- To introduce various scheduling policies of OS.
- To teach the different memory management techniques.

Learning outcomes

The Learning Outcomes of this course are as follows:

- Learn multiprogramming, multithreading concepts for a small operating system.
- Create, delete, and synchronize processes for a small operating system.
- Implement simple memory management techniques.
- Implement CPU and disk scheduling algorithms.
- Use services of modern operating system efficiently

- Learn basic file system.

SYLLABUS OF ELDSE-2B **Total Hours- Theory: 45 Hours, Practicals: 30 Hours**

UNIT – I (11 Hours)

Overview: Introduction, Computer-System Organization and Architecture, Multiprocessor and Clustered Systems, OS Operations, Multiprogramming and Multitasking, Resource management- process management, memory management, file-system management, Mass- storage management, I/O System management systems, protection and security. Virtualization, Distributed systems, Real Time Embedded Systems, Free and Open source Operating systems and Operating system services.

UNIT – II (12 Hours)

Process management: Basic concepts, Scheduling Criteria, Scheduling algorithms- FCFS, SJF, Priority, RR and Multilevel Queue. Process synchronization.

Concurrency and Synchronization: The Critical-section problem, Semaphores, Deadlock Characterization, Prevention, Avoidance, Detection and Recovery.

UNIT – III (12 Hours)

Memory management: Basic hardware, Address binding, Physical and Logical address space, Swapping, Memory allocation strategies -Fixed and Variable Partitions, Fragmentation, Paging, Segmentation, Demand Paging and virtual memory, Page Replacement Policies - FIFO, OPR, LRU.

UNIT – IV (10 Hours)

File system: Concept of a file, access methods, directory structure, file system mounting, file sharing, protection, file system structure, file system implementation, Directory implementation, allocation methods, free-space management, efficiency and performance, Disk scheduling algorithms- FCFS, SSTF, SCAN and C-SCAN.

Practical component (if any) – Operating Systems
(Python software)

Learning outcomes

The Learning Outcomes of this course are as follows:

- Implement various process scheduling algorithms
- Implement various priority based scheduling algorithms
- Implement various page replacement algorithms
- Implement various disk scheduling algorithms

LIST OF PRACTICALS (Total Practical Hours – 30 Hours)

1. Write a program to implement FCFS scheduling algorithm.
2. Write a program to implement Round Robin Process scheduling algorithm.

3. Write a program to implement SJF Process scheduling algorithm.
4. Write a program to implement non-preemptive priority-based scheduling algorithm.
5. Write a program to implement preemptive priority-based scheduling algorithm.
6. Write a program to implement SRJF scheduling algorithm.
7. Write a program to implement first-fit, best-fit and worst-fit allocation strategies.
8. Write a program to implement FIFO Page replacement algorithm.
9. Write a program to implement OPR Page replacement algorithm.
10. Write a program to implement LRU Page replacement algorithm.
11. Write a program to implement SCAN Disk Scheduling algorithm.
12. Write a program to implement SSTF Disk Scheduling algorithm.

Note: Students shall sincerely work towards completing all the above listed practicals for this course. In any circumstance, the completed number of practicals shall not be less than eleven.

Essential/recommended readings

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, "Operating Systems Concepts", Tenth Edition, John Wiley & Sons, 2018, ISBN:978-1-118-06333-0.
2. D.M.Dhamdhere, "Operating Systems", 2nd Edition, Tata McGraw Hill, 2011.

Suggestive readings

1. Andrew S Tanenbaum, Herbert Bos "Modern Operating Systems" , Fourth Edition, Pearson Education India, 2016. ISBN 978-9332575776.
2. William Stallings, "Operating Systems Internals and Design Principles", Seventh Edition, Pearson Education, 2018. ISBN 978-9352866717.
3. Garry Nutt, Nabendu Chaki, Sarmistha Neogy, "Operating Systems", Third Edition, Pearson Education.
4. Deitel & Deitel (2008), Operating systems, 3rd edition, Pearson Education, India
5. Achyut S Godbole, Atul Kahate, "Operating Systems", 3rd Edition, Tata McGraw Hill, 2011.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC ELECTIVES (DSE-3)

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Network Synthesis	4	3	-	1	Class XII passed with Physics + Mathematics/Applied Mathematics + Chemistry OR Physics + Mathematics/Applied Mathematics + Computer Science/Informatics Practices	Circuit Theory & Network Analysis (DSC-2, Sem I), Engineering Mathematics DSC(7, Sem III)/Signals and Systems (DSC-9, Sem III)

Learning Objectives

The Learning Objectives of this course are as follows:

- To study the basic frequency domain techniques and two port network parameters.
- To study the elements of network synthesis.
- To study and synthesise the one port networks with two kinds of elements.
- To study the synthesis of transfer function.
- To study and design the filters

Learning outcomes

The Learning Outcomes of this course are as follows:

- Apply the knowledge of frequency domain techniques and two port network parameters.
- Understand the basic concepts of network synthesis.
- Synthesise the one-port networks and transfer function.
- Determine the frequency response of filters.

SYLLABUS OF ELDSE-2C **Total Hours- Theory: 45 Hours, Practicals: 30 Hours**

UNIT – I (12 Hours)

Circuit Analysis: Concept of Poles and Zeros in complex frequency/s-plane, Initial and Final Value Theorem, Representation of Circuit Elements in s-domain, Circuit Analysis using Laplace Transform Method, The System Function for R-C and R-L Networks and their Impulse and Step Responses.

Two Port Network Parameters: Impedance (Z) Parameters, Admittance (Y) Parameters, Transmission (ABCD) Parameters, Hybrid (h) Parameters.

UNIT – II (10 Hours)

Elements of Network Synthesis: Causality and Stability, Hurwitz Polynomial, Sturm's Theorem, Positive Real Functions, Basis Synthesis Procedures.

UNIT – III (11 Hours)

Synthesis of One Port Networks with Two Kinds of Elements: Properties of L-C Immittance Functions, Synthesis of L-C Driving-Point Immittances, Properties of R-C Driving Point Impedances, Synthesis of R-C Impedances or R-L Admittances, Properties of R-L Impedances and R-C Admittances, Synthesis of R-L-C Functions.

UNIT – IV (12 Hours)

Transfer Function Synthesis: Properties of Transfer Functions, Synthesis of L-C Ladder Network with a 1-ohm Resistive Termination, Synthesis of Constant-Resistance Networks (Bridge and Lattice Type).

Filter Design: Ideal Filters, Low Pass Filter Design using Butterworth and Chebyshev approximation and Comparison between them.

Practical component (if any) – Network Synthesis
(Hardware/Software/Simulation Software)

Learning outcomes

The Learning Outcomes of this course are as follows:

- Verify the operation and response of typical electrical circuits.
- Determine the various parameters for two-port networks.
- Prepare the technical report on the experiments carried.

LIST OF PRACTICALS (Total Practical Hours – 30 Hours)

1. Mesh and Node Analysis of circuits using AC Sources.
2. Computation and plot of Poles, Zeros and Stability of a Function.
3. Study of step response of RC Network.

4. Study of step response of RL Network
5. Computation and plot of Inverse-Laplace Transform of a Function.
6. Determination of Impedance (Z) and Admittance (Y) parameters of Two-Port Network.
7. Determination of ABCD Parameters of Two-Port Network.
8. Determination of Hybrid (h) Parameters of Two-Port Network.
9. Designing of a Low Pass Filter (Butterworth Approximation) and study of its Frequency Response.
10. Designing of a Low Pass Filter (Chebyshev Approximation) and study of its Frequency Response.

Note: Students shall sincerely work towards completing all the above listed practicals for this course. In any circumstance, the completed number of practicals shall not be less than nine.

Essential/recommended readings

1. Kuo, F. F., "Network Analysis and Synthesis", 2nd Ed., Wiley India (2013).
2. M. E. Van Valkenburg, "Introduction to Modern Network Synthesis", Wiley Eastern (1984).

Suggestive readings

1. Aatre, V. K., "Network Theory and Filter Design", 3rd Ed., New Age International (2014).

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.